

# The genus *Anomobryum* Schimp. (Bryopsida, Bryaceae) in Australia

John R. Spence and Helen P. Ramsay

## Abstract

Spence, John R.<sup>1</sup> and Ramsay, Helen P.<sup>2</sup> (<sup>1</sup>National Park Service, Glen Canyon NRA, PO Box 1507, Page, AZ 86040, USA; <sup>2</sup>National Herbarium of New South Wales, Mrs. Macquaries Road, Royal Botanic Gardens, Sydney, NSW 2000, Australia) 2002. The genus *Anomobryum* Schimp. (Bryopsida, Bryaceae) in Australia. *Telopea* 9(4) 777–792. The genus *Anomobryum* has been revised for Australia and five species are recognized: *A. auratum* (Mitt.) A. Jaeger, *A. harriottii* (R. Br. bis.) Dixon, *Anomobryum* sp. (= *Bryum argenteum* Hedw.), and two new combinations made for species transferred from *Bryum*: *A. lanatum* (P. Beauv.) J.R. Spence & H.P. Ramsay, and *A. subrotundifolium* (A. Jaeger) J.R. Spence & H.P. Ramsay. Keys, descriptions, illustrations and distributions are presented for the species in Australia. Relationships with other genera in the Bryaceae are discussed.

## Introduction

In this study the genus *Anomobryum* (Bryaceae) has been examined in detail as a contribution for the Flora of Australia. *Anomobryum* is closely related to the widespread genus *Bryum* and most bryologists (e.g. Smith 1978, Crum & Anderson 1981, Noguchi 1994, Eddy 1996) consider it a separate genus, although Ochi (1970, 1992) retained it as a subgenus within *Bryum*. In general *Anomobryum* is distinguished by its very small size, julaceous stems, and leaves with a weak costa and smooth margins, all features that it shares with the silver *Bryum* species, such as *B. argenteum* Hedw. At least two species of *Anomobryum* are also silver in colouration like *B. argenteum* and its allies. The sporophyte generation in *Anomobryum* is remarkably variable in capsule shape and orientation. Peristomes are also extremely variable, and in some cases reduced to a single rudimentary layer, the origin of which remains unknown (Shaw & Fife 1984). Within the *Bryum argenteum* group similar capsule and peristome variability also exists (Tan & Koponen 1989).

*Bryum argenteum* was selected as the lectotype for the genus *Bryum* (E.G. Britten, 1918 Fl. Bermuda: 490). For reasons outlined in Spence and Ramsay (1999) we consider this an unfortunate choice for the type and have proposed that this be rejected and the genus be assigned a new type based on *Bryum caespiticium* Hedw. Although the species *B. argenteum* is treated as an *Anomobryum* for this study, the formal transfer will not be made until the Committee for Bryophyta has made a decision regarding the proposal. For arguments regarding the relationships of *B. argenteum*, see Spence and Ramsay (1999).

In this paper a full taxonomic treatment of *Anomobryum* for Australia is presented, with illustrations and keys. A discussion of the genus world-wide and its relationships with other members of the Bryaceae is included. Currently, we recognize five species of *Anomobryum* in Australia, of which three (two transferred from *Bryum*) have the silver coloration typical of *Bryum argenteum*. The five species recognised here are *A. sp.* (= *B. argenteum* s.s.), *A. auratum*, *A. harriottii*, *A. lanatum*, and *A. subrotundifolium*.

## Taxonomic treatment for Australia

*Anomobryum* Schimp., Syn. 382, 1860.

Type: *A. julaceum* (Gaertn., Meyer & Scherb.) Schimp.

Synonyms: *Bryum* Hedw. subgen. *Anomobryum* (Schimp.) Schimp., Syn. edn 2: 465 (1876).

**Derivation:** from the Greek, *anomo-* (different) and *bryum* (moss), in reference to differences from true *Bryum*.

Dioicous. Plants small in dense turfs on damp soil and rock. Stems 1–4 mm, julaceous, often branched by innovations; leaves small, mostly under 1.0 mm long, imbricate, obtuse to apiculate, margins mostly plane, unbordered; upper and mid-laminal cells rhomboidal to elongate-vermicular (3–10: 1 or more), often thick walled, lower laminal cells abruptly quadrate to short-rectangular (1–2: 1), wider than cells above; costa weak, not reaching apex to percurrent, rarely shortly excurrent, in cross-section lacking distinct guide cells; gemmae as leafy bulbils often found in leaf axils of sterile shoots. Perigonal and perichaetial leaves somewhat differentiated, somewhat enlarged and often with acute apices. Calyptra cucullate, shed early. Seta long-exserted, to 1.2 cm; capsule small, <1mm, shape variable, ovate with thickened neck to cylindric with narrowed neck, pendulous to erect; peristome double, highly variable, from well developed with both exostome and endostome, to endostome segments reduced with low basal membrane, cilia reduced or absent, or rarely peristome almost lacking. Spores small, 8–20  $\mu\text{m}$ .  $n = 10, 11, 12, 20$  (Fritsch 1991).

A worldwide genus of c. 50–60 species, most common in montane regions of the subtropics, tropics and the southern hemisphere, especially well represented in the neotropics. Only a few species occur in temperate areas of the northern hemisphere. The genus is represented in Australia and its territories by five species.

### Key to species

- 1 Plants silvery; upper portions of leaves lacking colouration, costa variable, weak to excurrent ..... 2
- 1\* Plants brown or green, not silvery; upper leaves green, costa weak, not reaching apex ..... 4
- 2 Leaf apex obtuse or rarely slightly apiculate, apiculus <3 $\mu\text{m}$  long; leaves often cucullate; basal lamina cells predominantly short-rectangular (2: 1), upper-middle lamina cells wide (>14  $\mu\text{m}$ ) 2–3: 1 length:width ratio ..... 5. *A. subrotundifolium*
- 2\* Leaf apex apiculate to acuminate, hairpoint or apiculus >8 $\mu\text{m}$ ; leaves not cucullate; basal lamina cells predominantly quadrate, upper and mid lamina cells narrow (<10  $\mu\text{m}$ ) ..... 3
- 3 Costa percurrent, upper leaf abruptly contracted to apiculus ..... 1. *A. sp.* (= *Bryum argenteum*)
- 3\* Costa strong, excurrent in hairpoint; leaf acuminate ..... 4. *A. lanatum*
- 4 Upper lamina cells elongate-vermicular (>6: 1) ..... 2. *A. auratum*
- 4\* Upper lamina cells short and broad (2–3: 1) ..... 3. *A. harriottii*

**1. *Anomobryum* sp.**

*Bryum argenteum* Hedw., *Spec. Musc.* 181 (1801).

Type: Europe; holo ?G, n.v.

*Bryum argenteum* var. *niveum* Wils., *Fl. Tasm.* 2: 191 (1859).

Type: Tasmania: Hobart (Surrey Hills) Gunn 1615; holo MEL.

*Bryum amblyolepis* Cardot *Rev. Bryol. Lichenol.* 27: 45 (1900).

Type: South Africa; holo ?PC, n.v.

*Bryum amblyophyllum* Cardot A.N.A.R.E. Rep. ser. B. Bot. 4 (1953) *orthogr. pro* *B. amblyolepis* Cardot.

*Bryum catenatum* Müll. Hal. *Proc. Linn. Soc. New South Wales Suppl.* 30: 142 (1906) *nom. nud. in synonym.*

Based on: Queensland: no locality, no collector (MEL); Victoria: Mt Ararat no collector [not located].

*Bryum hampeanum* Müll. Hal. *Gen. Musc. Fr.* 217 (1901) *nom. nud. in synonym.*

Based on: Victoria: Mt Ararat no collector [not located].

**Illustrations:** (all as *Bryum argenteum*) Smith fig. 401, p. 422 (1978); Catcheside fig. 159, p. 269 (1980); Crum and Anderson fig. 265 (A–G), p. 571 (1981); Noguchi fig. 213, p. 485 (1994); Eddy fig. 410, p. 121 (1996).

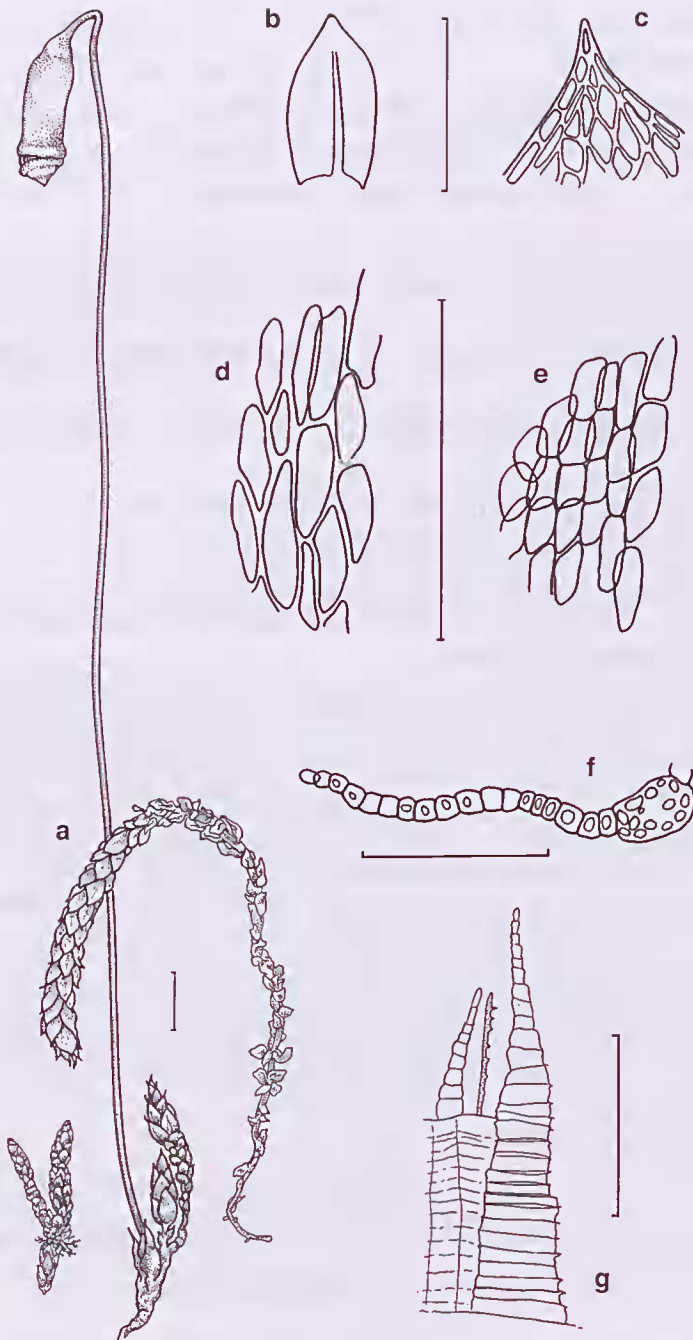
Plants small, in dense turfs, glossy silver-green when moist, silvery-hyaline when dry. Stems julaceous, fragile, crowded, 0.5–1.5 cm tall, branching by numerous subperichaetial innovations. Leaves ovate to ovate-lanceolate, 0.5–1.5 mm long, concave, imbricate, tapered somewhat abruptly to an apiculus or occasionally apices obtuse; upper portion ( $\frac{1}{2}$ – $\frac{1}{4}$ ) of lamina hyaline, margins plane, mostly unbordered; costae weak, percurrent or not reaching apex, in cross-section lacking guide cells and with a reduced stereid band; upper and mid laminal cells rhomboid-hexagonal, 40–70  $\mu\text{m}$  long (3–5:1), thin or firm-walled, basal laminal cells predominantly quadrate, thin-walled. Gemmae as bulbils often present in leaf axils of sterile stems. Perichaetia on short stems, leaves apiculate. Seta 1.2–2.0 cm long, red; capsule short <2 mm long, pendulous, ovate with thick often wrinkled neck, abruptly contracted to seta, bright red at maturity, opercula convex, apiculate; peristome double, exostome teeth 16, with narrow border, tapering to pale tip, outer face finely papillose; endostome segments 16, with narrow gaps, basal membrane  $\frac{1}{2}$  height of exostome teeth, cilia 1–3, nodose to short-appendiculate. Spores small 8–15  $\mu\text{m}$ .  $n=10$  (fide Ramsay & Spence 1996). (Fig. 1a–g).

**Habitat:** *Anomobryum* sp. (= *Bryum argenteum*) is especially common in disturbed habitats, pavements, walls, soil, rock crevices particularly in anthropogenic localities such as cities and towns. It prefers calcareous habitats and places that are high in organic nitrogen.

**Distribution:** a cosmopolitan species, common throughout Australia (W.A., N.T., S.A., QLD, N.S.W., A.C.T., VIC, TAS.). Fig. 6a.

**Selected Specimens:** Western Australia: Porongarups, G.G. Smith *s.n.*, 6 Oct 1959 (MEL ex WAU); Dundas Rocks, D. Kemsley *s.n.*, 21 Oct 1951 (MEL); Mt Barker, G.D. Mills *s.n.*, Aug 1946 (MEL ex WAU); Walpole-Nornalup N.P., D.H. Norris 26197 (BRI).

Northern Territory: Mt Connor, J.H. Willis *s.n.*, 17 Jan 1974 (MEL); Mt Ruddock, Harts Range, A.C. Beauglehole 44658 (MEL); Mt Connor, A.C. Beauglehole 22866 (MEL); Ayers Rock (=Uluru), A.C. Beauglehole 25880 (MEL).



**Fig. 1.** *A. sp.* (= *Bryum argenteum*). **a**, range of habits (dry) mid plant with sporophyte attached; **b**, leaf; **c**, apical leaf cells; **d**, mid-laminal cells; **e**, basal lamina cells; **f**, T.S. leaf; **g**, peristome. (**a**, **b**–**e** from W.B. Schofield 80124 (NSW); **a**, with sporophyte from *D. Sullivan s.n.* 1872–1890 (MEL); **f**–**g** from *H.P. Ramsay 3/77* (NSW)). Scale bars: **a** = 1.0 mm; **b** = 0.5 mm; **c**–**g** = 100µm.



South Australia: Kensington Park, Adelaide, *D.G. Catcheside* 79.155, Oct 1979 (AD); Fowlers Bay, *Mrs Richards s.n.* (MEL); Adelaide, *F.V. Mueller s.n.*, Jun 1852 (MEL); Bute Yorke Peninsula, *B. Copley* 797 (AD).

Queensland: Millaa Millaa, *E. Henry s.u.* (CANB); Lake Eacham *D.G. Catcheside* 76.76 (AD); Tinaroo Perimeter Road, *H. Streimann* 16985 (CANB); Tumoulin Rd, northwest of Ravenshoe *H. Streimann* 27070 (CANB); Big Tableland, *H. Streimann* 30829 (CANB); Atherton, *H. Streimann* 29166 (CANB); Tinaroo Dam, *W.B. Schofield* 80214 (NSW); Mt Bellenden Ker, *H. Streimann* 27446 (CANB); Lamington N.P., *J.R. Speuce* 5197 (NSW); Kogan, *M.E. Ballingall s.n.*, 17 Mar 1985 (BRI); Mt Glorious, *J. Sawyer and E.M. Ross s.n.*, 13 May 1985 (BRI); Purlingbrook, *J. Sawyer and E.M. Ross s.n.*, 22 Jul 1987 (BRI).

New South Wales: Between Rous and Wardell, *H.P. Ramsay* R530 (NSW); Hume (Murray) River, *S. Jeffcott s.n.*, 1886 (MEL); Broken Hill, *A.B. Court s.n.*, Jun 1955 (MEL); Warrumbungles, *I.G. Stone* 4059, 4063 (MEL); Tinderry, *H. Streimann* 5215 (CANB); Cobar Regeneration Area, *D.J. Eldridge BSCS* 738 with *M.E. Tozer* (NSW); 4.3 km SW of Nymagee on Gilgunnia Rd, *D. J. Eldridge BSCS* 581 with *M.E. Tozer* (NSW); Yathong Nature Reserve, *D.J. Eldridge BSCS* 64 (NSW); 9 km NE of Tchelery Homestead, *D.J. Eldridge BSCS* 641 with *M. E. Tozer* (NSW).

Victoria: Grampians, *D. Sullivan s.n.* (MEL); Wilsons Promontory, *I.G. Stone* 645 (MEL); Euroa-Mentone Road, *I.G. Stone* 9001 (MEL); Raywood, *I.G. Stone* 1705 (MEL); Mt Buffalo, *I.G. Stone* 7798 (MEL); Grampians, *I.G. Stone* 9165 (MEL); Gorae West, *A.C. Beaglehole* 1479 (MEL); Kulkynne, *J.H. Willis s.n.*, 16 Oct 1960 (MEL); Studley Park, *F.M. Reader s.n.*, 5 Sep 1883 (MEL); Creswick, *J.H. Willis s.n.*, 26 Jul 1942 (MEL); Melbourne University, *H.T. Clifford s.n.*, Jun 1947 (MEL).

Tasmania: Cataract Gorge, Launceston (no collector), Aug 1886 (MEL).

**Notes:** The species *Bryum argenteum* should be transferred to *Anomobryum* for reasons outlined above and in Spence and Ramsay (1999). Although Eddy (1996) comments on the similarity between the stems of this and *Anomobryum* species, he considers that the lack of apiculi (present, however, in *Bryum argenteum* var. *lanatum*), and differences in habitats exclude it. *Bryum argenteum* is a cosmopolitan species which has probably been introduced into many parts of the world. Its abundance in cities in developed landscapes and other disturbed habitats along with its general absence from native vegetation, suggests that it may have been introduced into Australia. Several unpublished varietal names appear on specimens, e.g var. *proliferum* (for those with bulbils), but these merely represent variability of characters within the species and do not represent separate taxa. Differences between this and the two other Australian silver species, *A. lanatum* and *A. subrotundifolium* are discussed under them.

**2. *Anomobryum auratum*** (Mitt.) A. Jaeger, *Ber. S. Gall. Naturw. Ges.* 1873–74: 142 (1875) (Ad 1: 804).

*Bryum auratum* Mitt., *Linn. Soc. Bot. Suppl.* 1: 67 (1859).

Type: Nepal, Lamben River, 7000 ft., *J.D. Hooker* 513; holo ?BM; syn NY.

Illustrations: Ochi, p. 157 fig. 36 (1969).

Plants small in dense golden-brown turfs. Stems to 5–7.0 mm tall, julaceous, branching by numerous subperichaetial innovations. Leaves broadly ovate, concave, 0.4–0.8 mm long, with apiculate to obtuse apices, margins plane, unbordered; costae weak,  $\frac{1}{2}$ – $\frac{2}{3}$  length of leaf, lacking guide cells; upper laminal cells short rhomboidal, 10–15  $\mu\text{m}$   $\times$  1–2  $\mu\text{m}$  (2–3: 1), mid-laminal cells elongate-vermicular, 30–45  $\mu\text{m}$   $\times$  6–8  $\mu\text{m}$  (6: 1 or more), walls thick-walled; lower cells lax, quadrate to short-rectangular. Gemmae not known. Australian collections sterile. Seta short; capsule short-ovate, red when mature, horizontal to sub-erect; endostome and cilia rudimentary, not well developed. Spores 11–13  $\mu\text{m}$ . (description of sporophyte taken from Ochi, 1969). No chromosome number available. (Fig. 2a–f).

**Habitat:** extremely rare and local. First recorded in Australia from a single collection in Queensland by Watts (Brotherus & Watts 1918) as *A. cyumbifolium* from 'Millstream

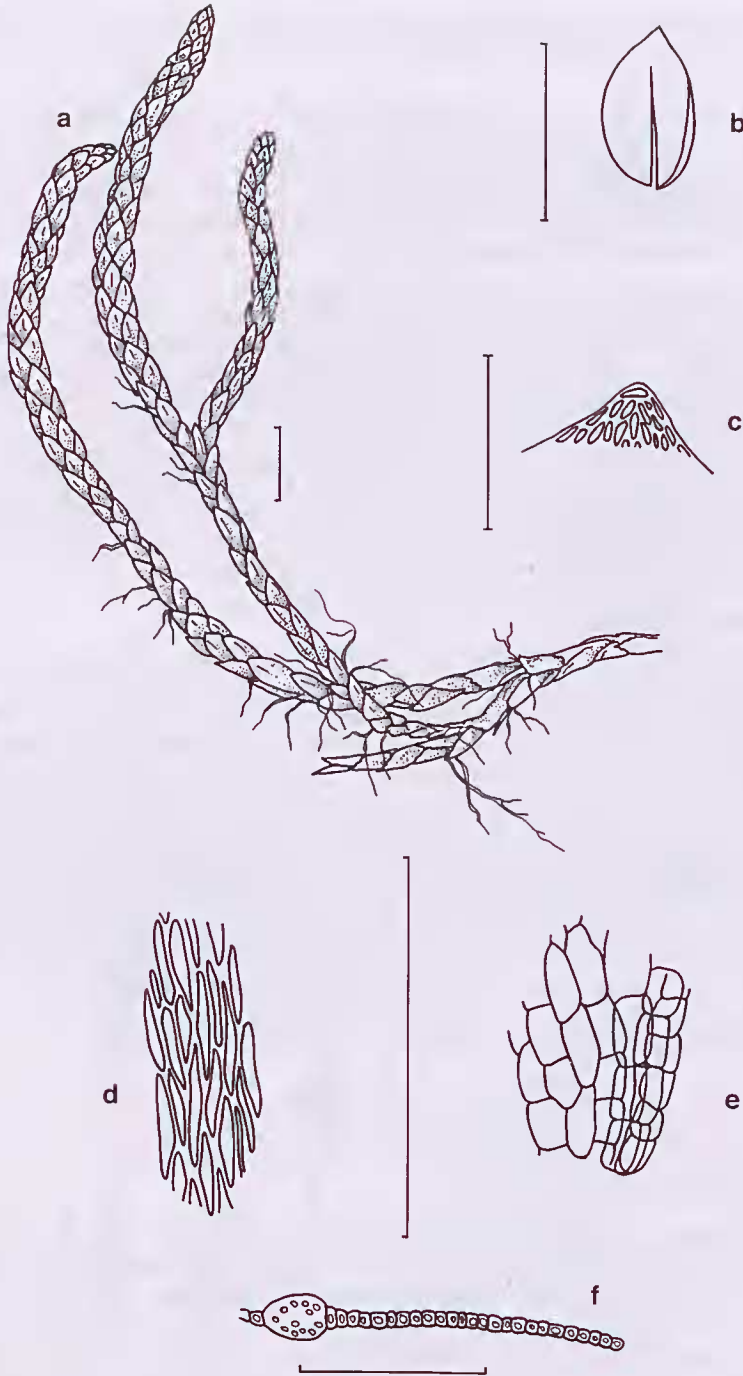


Fig. 2. *A. auratum* a, habit; b, leaf; c, leaf apical cells; d, mid-laminal cells; e, basal leaf cells; f, T.S. leaf. Scale Bars: a = 1.0 mm; b = 0.5 mm; c-f = 100  $\mu$ m.

River, upstream from Millstream Falls on wet basalt with *Bryum argenteum* (W.W. Watts Q532). *Anomobryum auratum* in Australia consists of golden-brown dense turfs on wet soil and splashed rocks near water.

**Distribution:** north-eastern Queensland at moderately high elevations (900–1000 m). Fig. 6b.

**Specimens:** Queensland: upriver of Little Millstream Falls, near park boundary, J.R. Spence 5129 (NSW); Wallaman Falls National Park, I.G. Stone 8518 p.p. and I.G. Stone 8508 (MEL); Millstream, Ravenshoe W.W. Watts Q532 (as *A. cymbifolium*) (NSW).

**Notes:** *Anomobryum auratum* is paleotropical in distribution, found in Africa, southeast Asia and the Phillipines, although not yet known from New Guinea. Australian collections are sterile.

Ochi (1970, 1992) did not record *Anomobryum* for Australia although *A. cymbifolium* (Lindb.) Broth. had been reported by Brotherus and Watts (1918) for North Queensland. The Australian specimens fall within the gametophytic variation and structure of the traditionally considered single paleotropical species, *A. auratum* (Mitt.) A. Jaeger to which it is referred here. Within *Anomobryum*, species often strongly differ in capsule characteristics, so the identification of our plants as *A. auratum* remains tentative until sporophytes are found. Although the plants are similar to named specimens from elsewhere, they are overall somewhat smaller.

**3. *Anomobryum harriottii*** (R. Br. bis.) Dixon, *New Zealand Institute Bull.* 3(4): 202 (1926).

Basionym: *Bryum harriottii* R. Br. bis., *Trans. New Zealand Inst.* 31: 45, 30 (1899).

Type: New Zealand, wet banks near Weka Pass, April, 1882, R. Brown s.n.; holo ?BM [H. Ochi, *New Zealand J. Bot.* 22: 179–182 (1984) rejects this as a type.]

*Anomobryum densum* Dixon, *Bull. Torrey Bot. Cl.* 42: 103 (1915).

Type: New Zealand: holo BM.

**Illustrations:** none known.

Plants small in dense bright green turfs. Stems to 0.5–2 cm in length, with numerous subperichaetial innovations. Leaves ovate to orbicular, 0.5–1 mm in length, concave, leaf apices obtuse, margins plane, unbordered; costae strong, nearly reaching apex to percurrent, in cross section lacking guide cells; upper and mid-laminal cells short and broad, 10–25  $\mu\text{m}$   $\times$  5–6  $\mu\text{m}$  (2–4:1), incrassate, thick-walled, cells at base short-rectangular. Gemmae not known. Australian specimens sterile. Seta 1–2 cm long; capsule horizontal to pendulous, ovate to pyriform, with a narrow neck; peristome double, exostome teeth 16, endostome segments reduced with short basal membrane, cilia absent or rudimentary. Spores 20–25  $\mu\text{m}$ . (Description of sporophyte taken from Sainsbury 1955). No chromosome number available. (Fig. 3a–f).

**Habitat:** This species occurs in mountain climates, where it favours damp rocks or soil-filled crevices on outcrops.

**Distribution:** widespread in the mountains of New Zealand as well as similar habitats in the New Zealand and Australian subantarctic islands including Macquarie Island. In Australia, *A. harriottii* has only been collected from Tasmania. It forms small bright green turfs on wet rocks. All Australian collections made to date have been sterile. Because of its small size, however, it is easily overlooked, and may be more common in Tasmania than the single collection suggests. Fig. 6c.

**Specimens:** Tasmania: Mt Franklin, A.V. Ratkovsky s.n., 7 Jan 1978 (HO).

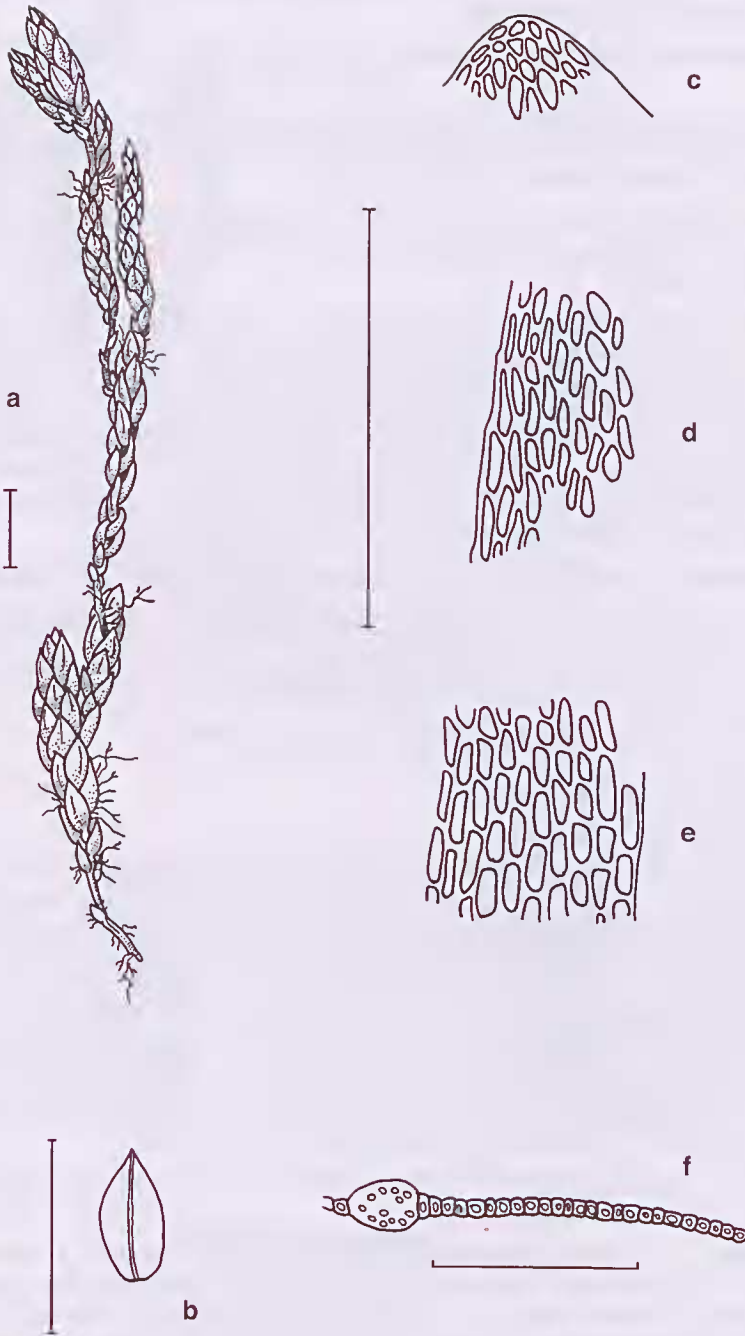


Fig. 3. *A. harriottii* a, habit; b, leaf; c, leaf apical cells; d, mid-laminal cells; e, basal leaf cells; f, T.S. leaf. ( from A.V. Ratkovsky s.n., 7 Jan 1978 (HO)). Scale Bars: a = 1.0 mm; b = 0.5 mm; c-f = 100  $\mu$ m.



Notes: *Anomobryum harriotii* can be distinguished from *A. auratum* by a combination of the bright green colour and wide upper laminal cells. Where fertile specimens occur the peristome is reduced.

The placement of this species in *Anomobryum* is based primarily on its overall habit, i.e. very small slender julaceous stems with ovate, obtuse leaves and a weak costa. The upper laminal cells are shorter and broader than in most species of *Anomobryum*, which tend to have very elongate-vermicular cells. Ochi (1992) placed this and related species in a new section *Yasudae* of subgenus *Anomobryum* in the genus *Bryum*, characterized by broad upper laminal cells. We agree with Dixon that it is better placed in the genus *Anomobryum*.

**4. *Anomobryum lanatum* (P. Beauv.) J.R. Spence & H.P. Ramsay, comb. nov.**

Basionym: *Mnium lanatum* P. Beauv., *Prodr.* 75 (1805).

Type: Europe; holo ?GL.

*Bryum argenteum* Hedw. var. *lanatum* (P. Beauv.) Hampe, *Linnaea* 13: 44 (1839) and *Bryol. Eur.* 4: 148 (1839) (fasc. 6–9, Mon. 78).

*Bryum bateae* Müll. Hal. *Hedwigia* 37: 93 (1898).

Type: New South Wales: Mt Dromedary, Miss Bate 1883; holo MEL, iso NSW.

*Bryum austroargenteum* Broth. *Proc. Linn. Soc. New South Wales Suppl.* 30: 127 (1906), *nom. nud. in synon.*

Based on: Queensland: Brisbane (Milton), *H. Tryon s.n.*; MEL, BRI.

*Bryum rotundum* Hampe in W.W. Watts & T. Whitelegge *Proc. Linn. Soc. New South Wales Suppl.* 30: 143 (1906), *nom. nud. syn. nov.*

Based on: Victoria: Ararat, *F.M. Campbell s.n.*; MEL, BRI.

**Illustrations:** (all as *Bryum argenteum* var. *lanatum*) Gangulee fig. 466, p. 971 (1974); Crum and Anderson fig. 265 (H–I), p. 671 (1981); Smith fig. 201 (4), p. 422 (1978).

Plants small in dense hoary silver-white tufts. Stems julaceous, 0.5–1.5 cm tall, branching by numerous perichaetial innovations. Leaves ovate-lanceolate, acuminate, 0.5–1.5 mm long, upper portion ( $\frac{1}{2}$ – $\frac{1}{4}$ ), lamina hyaline, margins plane, mostly unbordered; costae strong, excurrent into a slender silver hairpoint, often weakly recurved when dry, in cross-section lacking guide cells and with a reduced stereid band; upper laminal cells  $10\ \mu\text{m} \times 3\ \mu\text{m}$  (3: 1), narrow; mid-laminal cells rhomboid-elongate,  $25\text{--}30\ \mu\text{m} \times 6\text{--}8\ \mu\text{m}$  (3–4: 1), firm-walled—incrassate, basal laminal cells predominantly quadrate, thin-walled. Gemmae as axillary leafy bulbils on sterile stems. Perichaetial leaves lanceolate, acuminate with long hairpoint. Seta 1.5–2.0 cm long; capsule short, < 2mm long, ovate with wide mouth, thick often wrinkled neck; peristome double, exostome teeth 16; endostome segments 16, basal membrane  $\frac{1}{2}$  or more height of exostome, cilia 1–3, appendiculate. Spores small, 8–15  $\mu\text{m}$ . No chromosome number for Australian collections. (Fig. 4a–g).

**Habitat:** widespread on dry soil or rock, particularly in drier parts of Australia. Capsules rarely produced.

**Distribution:** cosmopolitan. Common in the subtropical and tropical areas of Indo-Malesia. In Australia (W.A., N.T., Qld, N.S.W., A.C.T., Vic.). Fig. 6d.

**Specimens:** Western Australia: on dry exposed laterite bluffs along Fitzgerald River, near Quaalip Homestead, *J.R. Spence* 4165, Oct 1989 (NSW); Howig Hill, Esperance, *N.N. Donner* 2860 (AD).

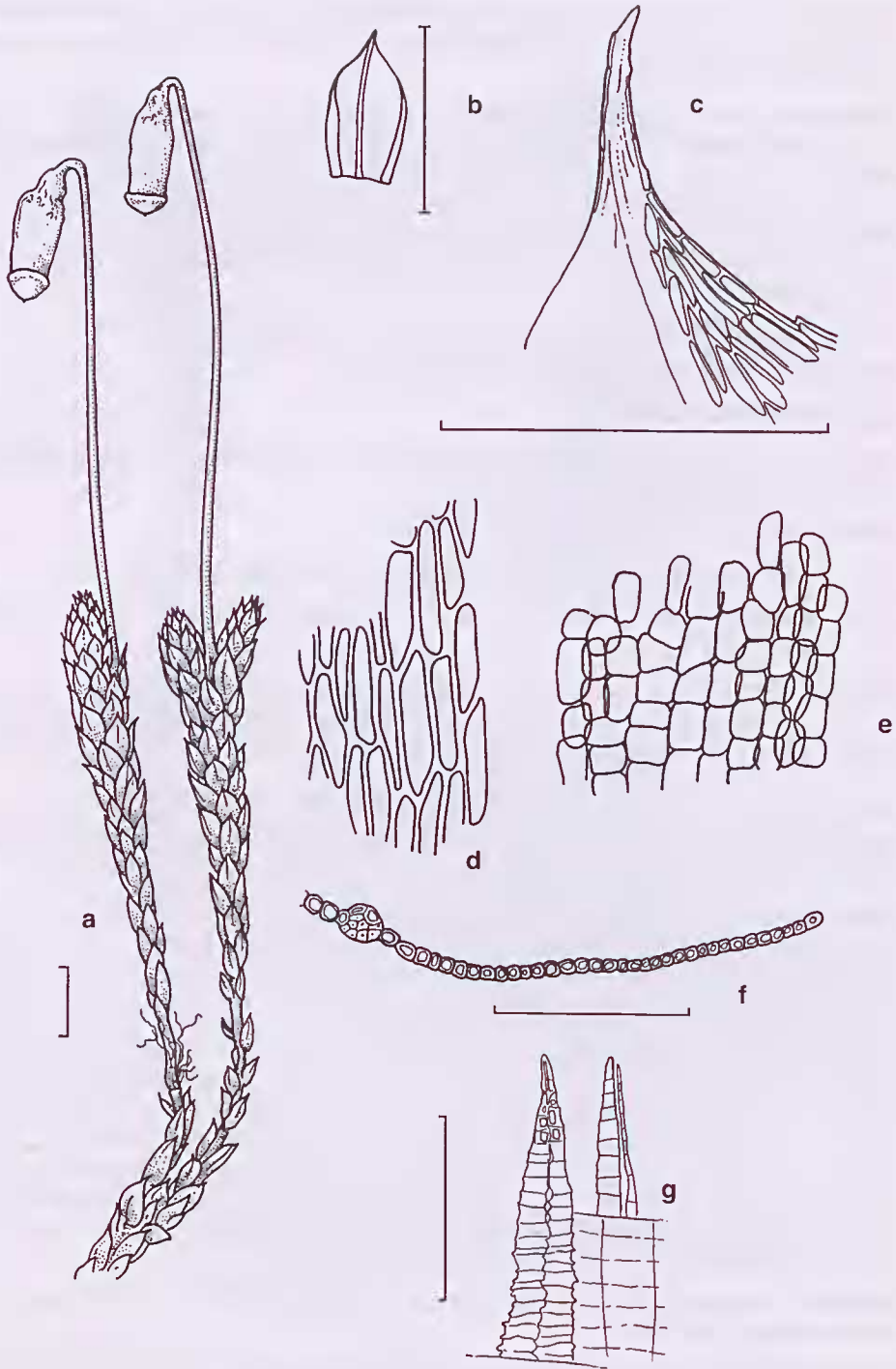


Fig. 4. *A. lanatum*. a, habits with sporophytes attached; b, leaf; c, leaf apical cells; d, mid-laminal cells; e, basal leaf cells; f, T.S. leaf; g, peristome. (a from I.G. Stone 12145 (MELU); b-f from W.B. Schofield 80214b (NSW); g from H.P. Ramsay R173 (NSW)). Scale bars : a = 1.0 mm; b = 0.5 mm; c-g = 100 $\mu$ m.

Northern Territory: Mt Connor, *P.G. Martin s.n.*, 15 Jun 1953 (AD); Mt Olga, *P.G. Martin 1111*, Jun 1953 (AD); Mt Olga Gorge, *D.G. Catcheside 76.311* (AD); Mt Olga Gorge, *I.G. Stone 5140* (MEL); Simpson's Gap, *P.K. Latz s.n.*, 11 Sep 1974 (DNA); Ormiston Gorge, *J. Wauchope s.n.*, 6 Jan 1975 (DNA); Alice Springs, *P.K. Latz 6354* (DNA).

South Australia: Mt Lindsay, *I.G. Stone 287* (MELU); Tomkinson Ra., *N.N. Donner 6708* (AD); Wilpena Pound, *D.G. Catcheside 53.238* (AD); Adelaide, *D.G. Catcheside 53.145* (AD); 115 km south of Kingston, *I.G. Stone 5321* (MEL).

Queensland: Mt Bellenden Ker, *I.G. Stone 12145* (MEL); Brisbane, (Milton) *H. Tryon s.n.*, Aug 1890 (MEL, BRI); Herberton, *C.J. Wild s.n.* (BRI); Ingham, *H. Streimann 37152* (CANB); Mt Baldy, *H. Streimann 30652* (CANB); Windsor Tableland, *H. Streimann 29747* (CANB); Bunya Mts, *W.B. Schofield 90545* (NSW, UBC).

New South Wales: Mt Tinderry, East of Michelago, *H. Streimann 5215* (AD); Warrumbungles, *I.G. Stone 4117, 4127* (MEL).

Victoria: Melbourne, *R.A. Bastow s.n.* (MEL); Mt Buffalo, *D.G. Catcheside 74.11* (AD); Gorae West, *A.C. Beaglehole 1479* (MEL).

**Notes:** Although generally considered a variety of *B. argenteum*, this species is morphologically quite distinct among the silver species of *Anomobryum*. Unlike most other silver species, *A. lanatum* has a strong costa excurrent into a long white hairpoint. The presence of the hairpoint gives the species a hoary white look. Very rarely a few specimens occur that are intermediate between this species and *B. argenteum*, or occasionally display leaves of both types. However, where both species occur together the hoariness of *A. lanatum* makes it easy to separate. Although most authors, including Eddy (1996) who suggests that the separation is habitat-determined, refer to it as a variety of *B. argenteum* we prefer to recognise *A. lanatum* as a separate species until more detailed studies on silver species world-wide are completed.

##### 5. *Anomobryum subrotundifolium* (*A. Jaeger*) *J.R. Spence & H.P. Ramsay, comb. nov.*

Basionym: *Argyrobryum subrotundum* Hampe, *Linnaea* 40: 312 (1876).

Type: Victoria: Mt Ararat, *Sullivan s.n.*, 1875; holo?; iso MEL, NSW ex MEL.

*Bryum subrotundifolium* *A. Jaeger, Ber. Tatig. St Gallischen Naturwiss. Ges. 1877-78: 43* (1879).

**Illustrations:** Seppelt and Greene, figs 8, 9. pp 628-629 (1998).

Plants small, in dense silver-yellow turfs. Stems julaceous, fragile, 0.5-2.0 cm tall, sparsely branched by subperichaetial innovations. Leaves broadly ovate to broadly ovate-lanceolate, 0.5-1.5 mm long, apex obtuse or occasionally tapered somewhat abruptly to a short apiculus (<3 µm), upper portion (1/2-1/4) of lamina hyaline, margins plane, mostly unbordered; costae weak, percurrent or not reaching apex, in cross-section lacking guide cells and with reduced stereid band; upper and mid-laminal cells rhomboid-hexagonal, >14 µm wide, mostly >16 µm long (2-3: 1), thin- or often firm-walled, basal laminal cells predominantly short-rectangular (2: 1), thin-walled. Capsules unknown. No chromosome number available. (Fig. 5a-f).

**Habitat:** mostly on dry rock or soil over rock in exposed sites, often at moderately high elevations.

**Distribution:** recorded for Australia (W.A., N.T., A.C.T., VIC, TAS) including Macquarie Is., also Antarctica (South Victoria Land). Fig. 6e.

**Specimens:** Western Australia: Boorara 10 km ESE of Kalgoorlie, *D. Kemsley s.n.* (MEL).

Northern Territory: George Gill Ra, Kings Canyon, *A.C. Beaglehole s.n.*, 2 Jul 1965 (MEL).

New South Wales: Cave Creek, Blue Waterholes, *J.R. Spence 4470* and *H. Streimann* (NSW).

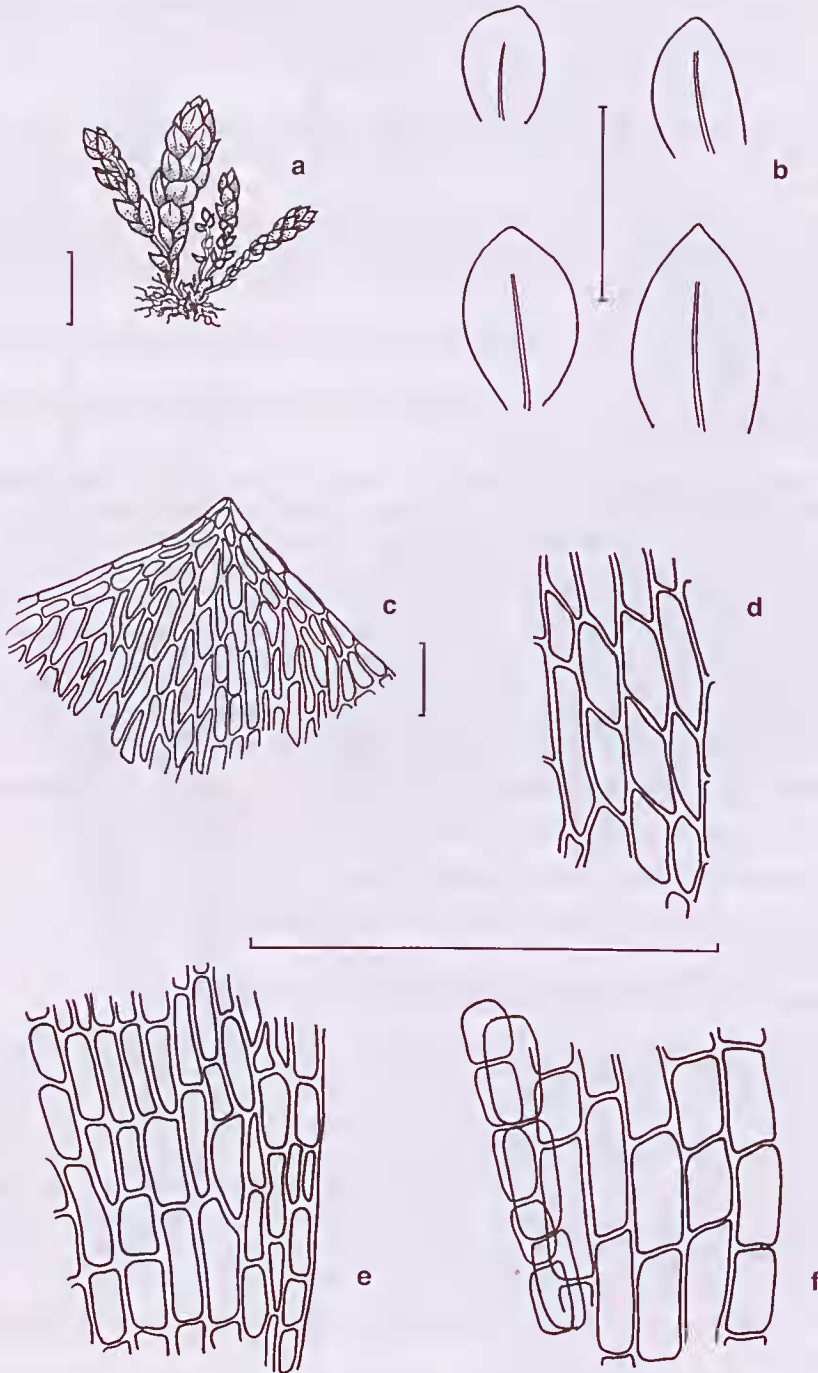


Fig. 5. *A. subrotundifolium*. a, habit; b, leaves; c, apical leaf cells; d, mid-laminal cells; e, f, basal leaf cells. (a from Sullivan s.n., 31 Jul 1875 (isotype MEL); b (above), c, d, e from Sullivan s.n., 31 Jul 1875 (isotype MEL); b (below), f from J.R. Spence 4470 (NSW)). Scale Bars: a = 1.0 mm; b = 0.5 mm; c–f = 100  $\mu$ m.



Victoria: Mt Ararat, *Sullivan s.n.*, 31 Jul 1875, (iso MEL): on roof, Parkville, Melbourne I.G. Stone 11893 (MEL).

Tasmania: Mt Wellington, *D.A. and A.V. Ratkovsky B368* (MEL).

**Notes:** A poorly known and undercollected species, *A. subrotundifolium* is related to the silvery species *A. sp.* (= *Bryum argenteum*) and *A. lanatum*, but differs from both of these in the obtuse leaf apex, leaves often cucullate, wider laminal cells, absence of hairpoint or apiculus, and basal laminal cells that are rectangular not quadrate. Recent DNA and morphological studies (Selkirk pers. comm.) have indicated it is distinct from *A. sp.* (= *B. argenteum*). In South Victoria Land, Antarctic, populations formerly named as *Bryum argenteum*, have been referred to *Bryum subrotundifolium* (= *Anomobryum subrotundifolium*) (Seppelt & Greene 1998). Mention is also made of archegonial and antheridial plants although no sporophytes were found. No fertile material has been located in Australian populations.

Although listed in Watts and Whitelegge (1906) as *Bryum subrotundifolium* from 'Vic.: Mt Macedon Sullivan' and also 'Mt Macedon Mrs Martin' this species is not listed by Ochi (1970) nor by Scott and Stone (1976). It is listed, however, as an endemic species in Streimann and Curnow (1989). Four specimens from the Northern Territory designated as *B. argenteum* in Catcheside and Stone 1988 p. 15, have proved on further investigation, to be *A. subrotundifolium*. However, there are a number of other specimens of *A. sp.* (= *B. argenteum*) and *A. lanatum*, since studied, that occur in the N.T. particularly the Alice Springs area (see Fig. 6).

### Excluded species

*Anomobryum filescens* Bartr. recorded from W.A. (1951) = *Eccremidium pulchellum* (Hook. f. & Wils.) C. Muell., vide Scott & Stone 1976: 124.

### Discussion

Recent phylogenetic work using molecular, anatomical and morphological characters has indicated that the family Bryaceae is polyphyletic, with traditionally recognized genera being more closely related to members of other families, including the Mniaceae, Meesiaceae, and Rhizogoniaceae (Cox et al. 1999; Cox & Hedderson 1999; Pederson 2000). Their studies clearly indicate that re-alignments of genera and revised definitions of some alternate-diplolepidous moss families are needed, particularly for the Bryaceae. Cox and Hedderson (1999) suggest that traditional gametophytic characters, which in past classifications have not been given as much weight as sporophyte characters, may provide valuable insights into moss phylogeny (cf. Spence 1987).

As recognized in this study, *Anomobryum* consists of about 50–60 species of small mosses with julaceous habits, heterogeneous laminal areolation, a weak costa lacking guide cells, with capsules that vary from erect to pendulous with a bryoid peristome that is either perfect or variously reduced. Based on traditional morphological characters, the genus appears to be most closely related to various sections of *Bryum*, in particular those centered around the species *Bryum bicolor*, *B. alpinum*, and *B. subapiculatum*. Recent DNA sequencing studies of the family, place *Anomobryum* in a clade that largely corresponds to the traditional subfamily Bryoideae (Cox & Hedderson 1999; Cox et al. 1999). This subfamily has been variously interpreted (cf. Pedersen 2000) but includes such core genera as *Bryum* s.l., *Rhodobryum*, *Anomobryum*, *Plagiobryum*, *Brachymenium* and *Rosulabryum*. Only a few predominantly northern hemisphere species have been used in the molecular work to date, however, and much of the range of morphological diversity in the subfamily remains unsampled in the

molecular studies. In a more recent analysis, Pedersen (2000) used morphological and anatomical characters to examine relationships in the family. In his analyses *Anomobryum julaceum* is shown as being ancestral to a clade composed primarily of species of *Mielichhoferia*, *Schizymenium*, *Pohlia*, *Orthodontium* and *Brachymenium*. However, the cladograms have low stability, and Pedersen states that more work is required. More recently, he has re-analyzed his data with the addition of *Leptostomum* as an additional outgroup (Pedersen, pers. comm.). His most recent unpublished results place *Anomobryum julaceum* and *Bryum argenteum* in a clade with *B. bicolor*, *B. alpinum*, and *B. rubens* (which is closely related to *B. subapiculatum*). These results, as yet unpublished, are essentially identical to our understanding of the relationships of these species.

Additional phylogenetic work is now being carried out (Spence & Ramsay in prep.) using a larger group of species that includes more of the gametophytic diversity in the Bryoideae. Currently, a paper is in preparation presenting our views of the subfamily relationships using cladistics (Spence & Ramsay in prep.).



Fig. 6. Distribution maps for *Anomobryum* in Australia. a, *A. sp.* (= *Bryum argenteum*); b, *A. auratum*; c, *A. harriottii*; d, *A. lanatum*; e, *A. subrotundifolium*. LHI = Lord Howe Island.

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